A Meta-Data Model for Knowledge in Decision Support Systems

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Background

Clinical decision support such as alerts, reminders and guidance are driven by rules often distributed among a variety of applications in a healthcare information system. Due to the increasing size of rule bases, there is a growing need to manage this dispersed knowledge in an integrated environment[1]. A system for management of executable clinical knowledge such as rules should (1) assist in the development and maintenance of rules throughout the rules' life-cycles, (2) support search and retrieval of rules in the knowledge base (e.g., rules for diabetes, rules created by a particular individual), and (3) facilitate the analyses of rules in the knowledge base (e.g., identify rules not updated in the last year).

In order to create such a clinical knowledge management system it is necessary to model the meta-data of rules. There have been efforts to document meta-data about rules within the Arden Syntax Medical Logical Modules' project. However, the maintenance and library categories in that project allow mainly free-text information about a rule [2]. We have created a comprehensive meta-data structure and taxonomy for describing clinical rules that supports the features of a knowledge management system. We also tested this model using a representative set of rules.

Methods

The model that we developed is informed by knowledge bases used by applications providing clinical decision support at the Brigham and Women's Hospital (BWH), which is a tertiary care academic hospital. The rules in these knowledge bases are encoded in local formats and have evolved over several years[3]. We conducted a comprehensive inventory and analysis of the existing knowledge bases in use at BWH. Based on this inventory, a survey of literature and an analysis of needs of a knowledge management system, we developed a comprehensive meta-data structure and taxonomy to describe the rules in the knowledge base. We developed an MS-ACCESS database using the meta-data structure as the data model for the rules. We tested the model by sampling 50 rules from the various decision support systems and entering their meta-data in this database.

Results

The meta-data model consists of the descriptors listed in the following table. The relational database schema reflecting this model contains 9 tables. The central "RULES" table contains fields that describe the main characteristics of a rule including -

Implementation date, Target setting, Purpose (efficiency, quality) and Category (values from the National Clearinghouse Guideline's Category concepts). The other 8 tables that represent the axes of the taxonomy are:

Table	Principal Attributes
Authors	personal details, role, expertise
Editors	rule and editor ID's
Evidence basis	details about the evidence and the local modifications
Implementation	the interface application and the event that evoked the rule
Revision history	date, author and revision content
Usage	data about counts/year, behavioral change and cost reduction
Users	user types – hospital physician, PCP, Nurse etc.
Keywords	UMLS concepts

We developed forms for easy entry and retrieval of rule information. We also developed a series of pre-formulated queries and forms that fulfill what we expect would be commonly requested demands for information from the knowledge management system.

Discussion

Testing of the system with 50 rules enabled us to refine the meta-data model and the taxonomy. We believe that this model can serve as a prototype to handle problems in managing knowledge in decision support systems. A more formal evaluation of the model should be conducted.

References

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